N02a 3D SPH simulations of the accretion flow around the neutron star in Be/X-ray binaries

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The Be/X-ray binaries represent the largest subclass of high-mass X-ray binaries. These systems consist of a Be star with an equatorial disk and, generally, a neutron star. Most of the Be/X-ray binaries show only temporary behaviour in the X-ray emission as a result of transient accretion onto the neutron star from the Be-star disk. Rencently, Okazaki et al. (2002) studied the interaction between the Be-star disk and the neutron star, using a 3D SPH code. In their simulations, however, the neutron star was modeled by a sink particle with the size of the Roche lobe, so no direct comparison with the observed X-ray data was possible.

In this paper, we study the accretion onto the neutron star in Be/X-ray binaries, using the 3D SPH code and the data from the simulations by Okazaki et al. (2002) for a coplanar system with a short period ($P_{\rm orb} =$ 24.3 days) and moderate eccentricity ($e = 0.34$). We find that a non-steady accretion disk is formed around the neutron star. the disk shrinks after the periastron passage of the Be star and restores its radius afterwards. While the mass-capture rate by the neutron star has a regular, strong dependence on the orbital phase, the orbital modulation in the accretion rate slowly gets damped. Our simulations show that the truncated Be disk model for Be/X-ray binaries is consistent with the observed X-ray behavior. we also study the acceretion flow in misaligned systems, in which the Be disk is inclined from the binary orbital plane. we discuss the effect of the misalignment on the disk structure and X-ray light curves.